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MEMORANDUM FOR: Executive Director, CIA

STAT FROM: [redacted]
Director of Data Processing

SUBJECT: Workstation Assessment

Attached are ODP working papers. They provide insight into the Office's views on the workstation problem and its relationship to other data processing matters. Clarifications can be provided as needed.

STAT [redacted]

Attachment
as stated:

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ED/ODP [redacted] tp (13Dec83) [redacted]

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I. OVERVIEW

1. INTRODUCTION

The formation of the Workstation Environment Working Group, under the auspices of the Information Systems Board, established the high priority and interest in the next generation of automated workstations. The charter of the group was to focus on requirements such as combining word and data processing into a single workstation/terminal. Curiously, this "requirement" was phrased in 'engineering terms' (i.e., to assess the integration of functions in the workstation) rather than to determine the requirement which answers the question: "What is the relationship of word processing functions to data processing functions for the CIA?" (a question that goes to the 'heart' of the SAFE program and the DO ALLSTAR upgrade).

Because the issue was 'forced' by the engineering orientation of the 'question' and because the engineering issue was narrowly focused on the workstation, the Working Group then struggled with a difficult problem that could not be adequately addressed in its interim report. This paper explains why the issue is too narrowly focused when it deals only with the workstation.

2. EXECUTIVE SUMMARY

Before attempting to address this issue, it should be noted that these questions are not of recent origin at the CIA, nor are these questions unique to the Agency. Many of our general data processing needs are application of marketplace activities, primarily those in the area of office automation, publishing, and large management information systems. While Agency interests in computer modeling and simulation are more closely tied to specific Agency needs, there is significant activity in other, large, research centers, that the Agency has capitalized upon. It is important for the Agency as a whole to keep abreast of developments in classical modeling activities as well as work in knowledge based systems and decision support systems.

The admonition to remember history for fear of repeating it is well taken here. An approach to understanding the workstation and the associated functionalities it makes available to Agency users is by studying a major undertaking in office automation in the Agency. This example is Project SAFE.

When the SAFE concept was first expressed, over eleven yeas ago, it established the need for the all-source intelligence analyst to have access, at the analyst's desk, to a variety of data services--presentation and manipulation of electrical cable traffic, analyst-to-analyst communication and preparation and editing of intelligence reports. The engineering analysis of these requirements led to the definition of a system to satisfy these requirements which utilized distributed processing in a tri-level architecture.

The three levels of this architecture are: a background processing environment that contains the fundamental services which require extensive computation, a foreground environment that obtains these back-end services and integrates them for the user, and a workstation environment that presents the SAFE functions to the user. This architectural concept has remained valid through the redirection of the SAFE program.

One of the more complex issues for SAFE, and one that has been most problemmatical for the requirements group within the program office, has been to understand and communicate to the end users, the relationship of the user-interface, (i.e., that which appears on the screen and keyboard of the workstation) to the distributed processing, tri-level architecture. It is a naive engineering view to think that what appears at the workstation is only, or even primarily, a workstation issue.

There are three major precepts upon which the SAFE user-interface is being developed. The first requires that all SAFE functionality be accessible from a single workstation. The second requires that all functionality be accessed by a uniform set of procedures and commands (i.e., the SAFE User Language is consistent in nomenclature, syntax and semantics). Thirdly, each independent function should allow transfer of data to the other functions without the user being required to translate or perform administrative activities between functionalities.

The first requirement does not present significant challenges for SAFE as all services are text services and do not involve unrelated capabilities such as medium resolution, imagery graphics (SAFE has a business graphics capability as a

long range requirement) or electronic signals processing/display. These, latter, applications have significant impact not merely on the design of the workstation but also, and primarily, upon the design of the communications network that distributes the data. In an electrical engineering sense, these types of services do not look like nor behave like text services in an information/data processing system.

The second requirement for uniformity in addressing each functionality imposes a complex translation process for the data processing system. Each service or distinct functionality in a data processing system has its own domain of concepts. Database management systems and electronic mail systems each can handle the same set of data. .But each views the data differently and provides related but not identical approaches to the data processing. An apt analogy is the commerce which bridges two cultures. Problems often hinge upon there being no linguistic constructs that can bridge societies that lack identical conceptual frameworks. In SAFE, the foreground activity must attempt to bridge these semantic differences. The syntactic and presentational aspects of the workstation are trivial problems by comparison. The semantic bridges in the foreground processing are the critical design issues.

The third requirement exacerbates the second. While the second requirement is only to bridge the semantic differences where there are commonalities, the third requirement creates bonds between functionalities where none may be inherent in the underlying services. To pass meaningful (from a user's perspective) data between a database management system and an electronic mail system can require the augmentation of each functionality in the background environment in order to establish the necessary, logical or user-interface connection.

The foregoing demonstrates that to discuss workstation functionality is really to discuss the integration of disparate data processing functionalities. This, in turn, requires a system's view of the distributed processing environment and the communication subsystems that link them. The advent of the personal computer provides opportunities for various distributed processing allocations ranging between all processing performed in the personal computer to all processing performed in a host network. The opportunities to satisfy a set of requirements belong to the systems engineers, not the end users, unless both are the same individuals.

The marketplace is attempting to provide systems which integrate various sets of functionalities. For example, the LOTUS 1-2-3 product integrates spread sheet, data base and

graphics within a wholly personal computer environment. Applied Data Research and CINCOM have each developed (are developing) an integrated set of data base and editing products for the mainframe computer. There are initial products from the personal computer software vendors to provide some linkage between personal computer applications and associated files supported on mainframe computers. (See reports on the recent COMDEX meeting in Las Vegas). Functional integration of the display and the use of non-keyboard data manipulation techniques (mouse, touch sensitive screens) have been promulgated by a number of vendors, most notably, Xerox and Apple.

As the need for functional integration evolves so will the solutions offered within the marketplace. There will always be a need to tailor and support these tools for our Agency requirements. The important point is to realize that these are systems issues and not subsystem or workstation selection problems.

Beyond the issues of functional integration are the problems of performance, reliability, maintainability and security.

It is possible within a personal computer to "layer" various applications (functions) on top of the personal computer's operating system. While this may achieve the specified functionality, it does not guarantee the adequacy of the systems performance. A tailored design that achieves high performance for an application usually sacrifices the functional integration. Thus, the user would see high performance modes: a personal computer mode, a word processor mode, a terminal mode--all in the same device, but the user must integrate the various activities.

The more components added to a system, the less reliable it is. A personal computer will not show the same degree of resistance to failure as a simpler terminal. A more complex communications network (to support the added functionality at the workstation) will require redundancy to assure reliable communication. Linked computer systems, having intelligent workstations, foreground and background processing will require a complex computer network to guarantee connectivity and service reliability.

Each different device and computer system requires the associated expertise and resources to keep it operational. System growth--adding users and capabilities--requires ever increasing people and dollars to keep the systems "on the air." Whatever vendors provide equipment to the Agency will

require the Agency to become sufficiently knowledgeable in each vendor's equipment to identify problems and assess alternative solutions. It cannot be otherwise if we wish to entrust to automated technology the Agency's vital information. This has been our experience over twenty-five years of growth in automation.

Perhaps the area of system design which makes Agency activities most distinct from market place activities (and also adds significant system cost) is system security. Issues involve both computer security (privacy and compartmentation, authentication, audit, and inter-system access) and communication security (data protection and electrical emanations reduction). Careful evaluation of security risks and good engineering design are required to avoid problems similar to those that arose in the development of the SAFE bus subsystem.

3. ASSESSMENT

The relationship of the workstation to the integrated set of functionality that may be required of it is no less complex than the relationship of the workstation to other (distributed) processing that may support it. The design of a system is too complex not to be placed in the hands of people specifically designated to perform it. On the otherhand requirements should not be left, by default, to the system's designers. The characterization of a workstation is not to be confused with requirements definition. This process, subsystem (i.e., workstation) specification is a process that occurs after functional requirements have been provided. It is an engineering function. If those who have been charged with determining requirements are performing engineering services, then who is establishing the requirements?

Perhaps the question begs the answer. It may be impossible, a priori, to determine requirements, leaving only an engineering, "cut and try" approach. If this is the case, then the expertise required is in the technology and not the application, with relationships subordinated accordingly.

There are no obvious answers. But it may be a better investment (of trust) to rely upon those who demonstrate a better understanding of the problems.

This overview is preface to a paper which shall evolve into the Teleprocessing Plan for the Office of Data Processing. ODP's current experience and installed systems base provide both a departure point and a set of constraints in the evolution of the Office's current services. In some areas radical departures from current solutions will be needed.

An Office meeting will be held to review both near term problems and larger term projects (e.g. the New Building Project) during the early part of January. Participants from other components will include representatives from major customer organizations as well as the Office of Communications. The meeting is primarily focused on communications and connectivity issues and will 'dovetail' other ODP planning activities.

It should be noted that the Office prepares other planning documents and system design documents (for example the SAFE System Design Document and the Processing Plan). The attached paper provides a review of ODP's current 'front end'. After the Teleprocessing Planning Conference the paper will be expanded to include the assessment of near term and longer term problems and ODP's approaches to these problems. Many system issues will not be resolved until completion of specific systems studies, which will also be identified in the Teleprocessing Plan.

II. Plan

1. Introduction:

This plan attempts to define the Standard Workstation which will follow the current Delta Data terminal. It also explores the communications systems including hardware and software that will be required to support a follow-on workstation.

The main thrust of the paper is that the workstation and the communications architecture which supports it are intimately related. A change to one must be considered in light of the impact on the other. They are not separate, and must be considered on an integrated basis.

2. Current Situation:

2.1 Agency Standard Terminal Hardware

The Agency Standard Terminal currently is the Delta Data 7260/8260. The contract for the 7260/8260 was let in February 1979 and was recently extended to expire in February 1986. Though the 8260 is currently being deployed as the standard terminal, it is the functional and operational equivalent of the 7260.

Both devices are based on a TI 99000 microprocessor with 4 MHz clock, 64KPROM, 80KRAM, bi-directional hardware flow control, and an AC power outlet. Several older versions of the Delta Data devices still exist in quantity throughout the Agency including 1196 older 7260s based on a TI 9900 microprocessor, and 500 Delta Data 5260s, the original standard terminal.

Other devices such as RAMTEK color graphics, TEKTRONIX graphics and the like also are installed in small quantities. The Delta Data terminals connect to the central service via asynchronous TTY circuits ranging in speed from 1200-9600 baud. A gradual conversion to total 9600 baud is currently underway. Older Delta Data 5260s can run up to 4800 baud.

2.2 Standard Terminal Software:

The Delta Data 5260 is a hard wired device and has no internal control program. The 7260/8260 line run Version 3 of that terminal's control program, the version specifically developed to provide support for the SAFE software. Included in the terminal control program is the ODP unique protocol. Version 3 of the terminal control program will exist for a

period of time necessary to develop, and contract, several software enhancement to the terminal. These enhancements can only be placed in those 7260s and 8260s which house a TI 99000. Enhancements planned include terminal features such as APL support, table driven menus, memory compression and others. Also a local host support package will be developed for the disk-based Delta Data (PC-like) which will be compatible with most major software packages available on the commercial market. Printer support and improved protocol software are also to be developed, all by the early 1985 timeframe. Actual installation of the software involves a hardware change to the PROM set of each terminal and is a labor-intersive activity.

The protocol mentioned above is a version of the Communications Access Method (CAM). It is resident in the terminal and the IBM host. A version of CAM exists for all Delta Data devices. CAM protocol is an ODP developed and written package unique to our installation. It supports the facilities implemented in GIMS based systems, the Host-Based Word Processor, AIM, the Full Screen editor, the SAFE development software, the DDO Allstar Upgrade, and others. The CAM protocol offers advantages to the developer and the user in its exploitation of features in the terminal. However, because it is unique it requires customization of the terminal.

2.3 Standard Word Processor Hardware:

The Agency Standard Word Processor is a family of devices from WANG, Incorporated. All of the various device configurations utilize the current WANG workstation, a Z80 based device. Over STAT WANG workstations are installed in Agency Metropolitan space.

The WANG workstation possesses few enhanced terminal features but, of course, excellent text editing and formatting capability. The workstation is connected via coaxial cables to a hub possessing most of the storage capability. Word processing is performed directly in each workstation. The largest hub, the Alliance system, is a small distributed system with data base services, local hard disk storage, and capability to physically connect up to 32 workstations. Because of performance issues, the normal Alliance configuration runs no more than attached 20 devices.

2.4 Standard Word Processor Software:

WANG software in all versions is a proprietary product of the company. The communications protocol connecting the workstation to the hub is a unique product developed by WANG.

WANG hubs, Alliance and others, can be connected to a central computer such as our VM system over several different types of circuits. The WANG is capable of communicating as a dumb Teletype device, a 2780/3780 bisynchronous device or as a 3270 IBM terminal. Our mainframe software does not support 3270 devices, thus the WANGs are being connected to the central service via bisynchronous circuits which allow a maximum of two devices on the hub to communicate simultaneously with the mainframe. WANG systems are seriously limited as a TTY device in that only two lines can be attached to the normal Alliance System.

2.5 Front End Processor Hardware:

The front end processor currently employed by the Agency is a COMTEN communications processor. The current COMTEN configuration supports a maximum of 384 circuits per device. Most of the circuits are configured as asynchronous lines to match the Delta Data requirements. Bisynchronous circuits for printers and WANG connections are also resident in each COMTEN as part of the total 384 circuits. An upgrade to the COMTEN software will allow 512 circuits per COMTEN when it is developed and tested approximately 18 months from now.

The COMTEN connection for terminals is a single line per device directly connected via twisted pair wire. The maximum circuit speed the COMTEN can support in the 384 configuration is probably 9600 baud, though COMTEN has noted a possible development for 19.2KB service. Any higher line speed support from the COMTEN involves a loss in the number of devices which can be connected, i.e., the same COMTEN Memory Interface Module can support sixteen 9600 baud circuits, but only two 56KB circuits.

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COMTEN capability line connectivity for a projected [redacted] terminals running at 9600 baud or more is a major teleprocessing issue for ODP. Note that twenty COMTENS are used to support the present [redacted] terminal base in five Computer Centers. Some terminals have more than one line but many COMTENs would be needed to support [redacted] devices. Obviously, if the follow-on workstation requires graphics support in the 56KB range, we cannot support a large number of those such devices with the current COMTEN architecture. (It should be noted that even a 56KB data rate is not suitable for good graphics support). Some kind of clustering and higher bandwidth service will be necessary. Section 42 further develops this issue.

2.6 Front End Processor:

The COMTEN software is intimately aligned with the terminal software. Currently the terminal does not support the standard XON/XOFF initiation/termination characters (flow-control) and uses its own control mechanism which COMTEN recognizes. Though we can convert to an industry standard, the transition involves a real dilemma. -- "How do we get the COMTFN to recognize the right set of characters for the right terminal while we perform the transition?" The transition for Delta Data devices again involves a massive prom change in the terminal. A solution is currently being discussed.

2.7 Host Hardware/Software:

The IBM hosts currently recognize a device attached to the network and then use an appropriate software package to interpret the signals from that device. For instance, if a Delta Data 5260 is recognized the proper CAM protocol for that device is involved. We make use of software written for the TEKTRONIX to connect many non-standard devices to the network, such as any odd terminal currently attached. This provides a "dumb" connection and does not provide the normal functionality. The IBM hosts currently also run a unique Access Method (CZAM), which interfaces the terminal to the operating system.

3. Follow-on Terminal - Device Itself:

3.1.1 Path 1:

The follow-on terminal presents the two path choice discussed her. The first path is to provide a transitional device which will support a myriad of user-requested new capabilities, but which will continue to service those applications whose software is tuned to the Delta Data functionality. That means basically that the device must be capable of interrupting CAM-based commands and emulating a Delta Data at that point. That also means that a customization of the device must occur somewhere in the development cycle.

3.1.2 It appears likely that the user-requested features will include use of PC-like commercial software packages, graphics support, and word processing support. It also appears that Xerox 8010 or LISA-like integrated software approach is desirable. If we just examine these requirements in light of the architecture, the issues get clearer.

3.1.3 PC use implies local storage of data which has security implications. It also implies that a user would like

to use the communications facilities to downline load a portion of a large data base and massage it with, perhaps, a piece of commercial software. This requires high bandwidth in order to achieve reasonable response time. That in itself presents the difficulty of integrating software such that the user doesn't have to log on to the central service, transfer data, log off, load a commercial disk, recall the data, and begin work. More transparency is desirable here, but the implied software sophistication required is huge.

3.1.4 In addition, if the user wants to massage data and then update his mainframe data base, a whole new issue of currency of the data arises. Distributed processing has always presented this difficulty, but has not yet solved it well.

3.1.5 Graphics support normally involves transmission of large quantities of data (say 500,000 bits/image). Our current line speed of 9600 baud is just not adequate for this type of support. We are exploring some higher bandwidth solutions which could involve clustering of devices around a channel-attached controller or a LAN of some sort. The difficulty lies in the large numbers of devices we are talking about supporting. We currently expect the follow-on architecture to provide a mix of speeds and support, e.g., 9600 for text workstations and older devices, up to 500KB for graphics and data base transferable workstations.

The challenge lies in supporting these new requirements as we transition from the current architecture to a new one.

3.1.6 Word processing support in the terminal device again involves the same issue as the PC connection. There are multiple commercial word processing packages which could meet the Agency's needs, but the integration of those packages with host-supported data bases and data storage presents the real technical issues. The use of a common user language and appropriate training for it is implied here as well.

3.1.7 The last issue for the follow-on device is the integrated software approach. The issue of functions such as mail, data base access, software package use, word processing, graphics and others, yielding from the user's perspective a completely integrated world is a major development. The SAFE project currently comes closest in attempting some of this integration, but it doesn't do all of it.

3.1.8 Development of a device which does all the above, plus development of the integrated features necessary to support it adequately for our user population is a major ODP task and a major resource initiative.

3.2 Path 2:

Path 2 involves providing a limited capability device which adds some features such as the PC device, but not others such as graphics, software integration and the like. The entire current communications architecture could be used to support the device at current line speeds provided limited data transmission is made. Connectivity issues may be solved by use of clustering devices.

The approach falls short of what our understanding of the user requirements for a follow-on workstation are.

4. Follow-on Terminal - Communications Impact:

The follow-on device specified in Path 1 above cannot be supported by our current communications architecture. Possible related changes to both hardware and software are as follows:

4.1 3270 Protocol Support:

3270 protocol support will probably be implemented. This will allow devices to be attached to standard controllers if necessary for clustering requirements. Note that while 3270 protocol may solve connecting issues, there may be a noticeable performance degradation. It also allows for use of standard software packages in the COMTEN and hosts. LAN's contract support 3270 protocol, but most use a customer protocol to provide better performance. As a transition strategy for the large Delta Data based projects, some planning for encapsulating CAM protocol within a 3270 envelope and having the terminal capable of interpreting both is currently being discussed. Performance is an issue here as is the customization of the workstation and the communication network. Any current PC, such as the WANG PC could be modified to work this way with some significant software development. One of the traps that always confronts us is that much of the standardized, commercial support, both hardware and software, has been developed to support low speed, long distance telephone line networks and presents mileage difficulties in being adapted to Agency/ODP requirements.

4.2

STAT Connectivity for [redacted] terminals remains a significant issue. It is fairly obvious that some sort of clustering device is required. That device could be a channel attached controller (IBM 3274) with low performance, a LAN with better performance or a COMTEN attached multiplexor (Timeplex M24 or M48 running X.25) or a combination depending on bandwidth needed by the device.

4.3

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Bandwidth implications of eventual support for [redacted] advanced devices would involve a complete revamping of the data communications in existing buildings and between existing buildings.

5. Summary

User requirements will force high bandwidth in the terminal in order to accomplish required functionality. The high bandwidth has to be common throughout the network because the system can only perform as well as its weakest link.

With high bandwidth throughout the network, no functional restrictions on the workstation exist. Workstations then requires suitable hardware and software to implement necessary integration and transition.